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Harvard LTER Schoolyard Program

Teacher Developed Lessons and Documents that integrate Harvard Forest Schoolyard Ecology Themes into curriculum.

- Lesson Title:
  Shepley's Hill Vernal Pool
- Teacher/Author: Judy Gibson
- School: Francis Parker Charter Essential School
- Level: Middle School-7th and 8th Grade
- Date: April 3, 2014

Shepley's Hill Vernal Pool

Ecology unit for 7th and 8th graders at the Francis Parker Charter Essential School

The pool

The students

The focus of the vernal pool unit is observation and making inferences

Collecting data

- Vernal pool unit in the spring every two years
- What happens to the pool the rest of the time?
- How to get data throughout the year?
- The after school group
- Data now from Fall 2009 to present

The after school group

- Thursdays through the spring then occasional for the rest of the year.
- Some years we expanded into other science activities during the winter
- Numbers of students have fluctuated-at its height about 10 , recently down to one

Winter trips – measuring ice thickness

Two weeks ago! March 17th

Later spring trips, in past years, sampling for organisms

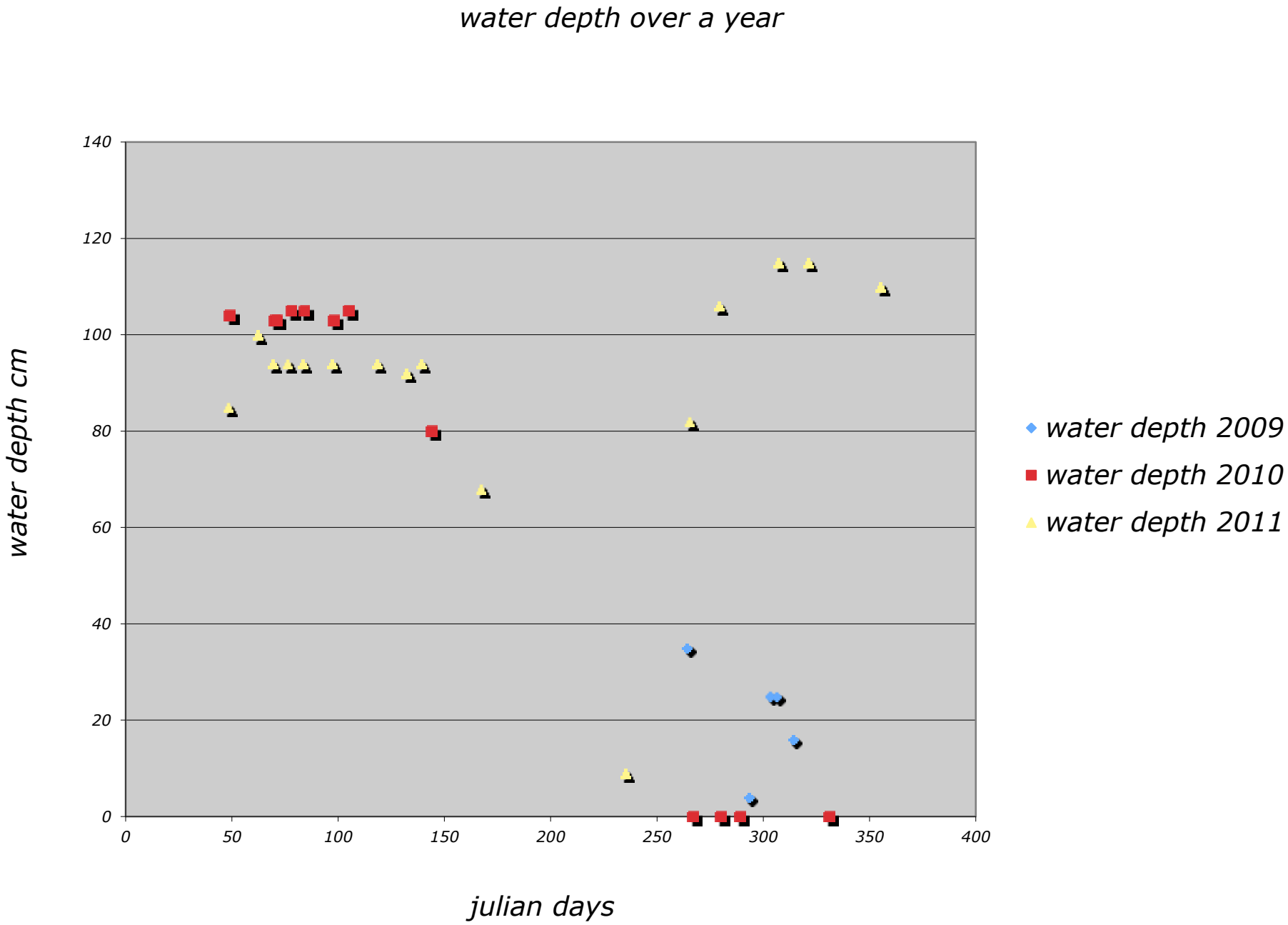
Data collection

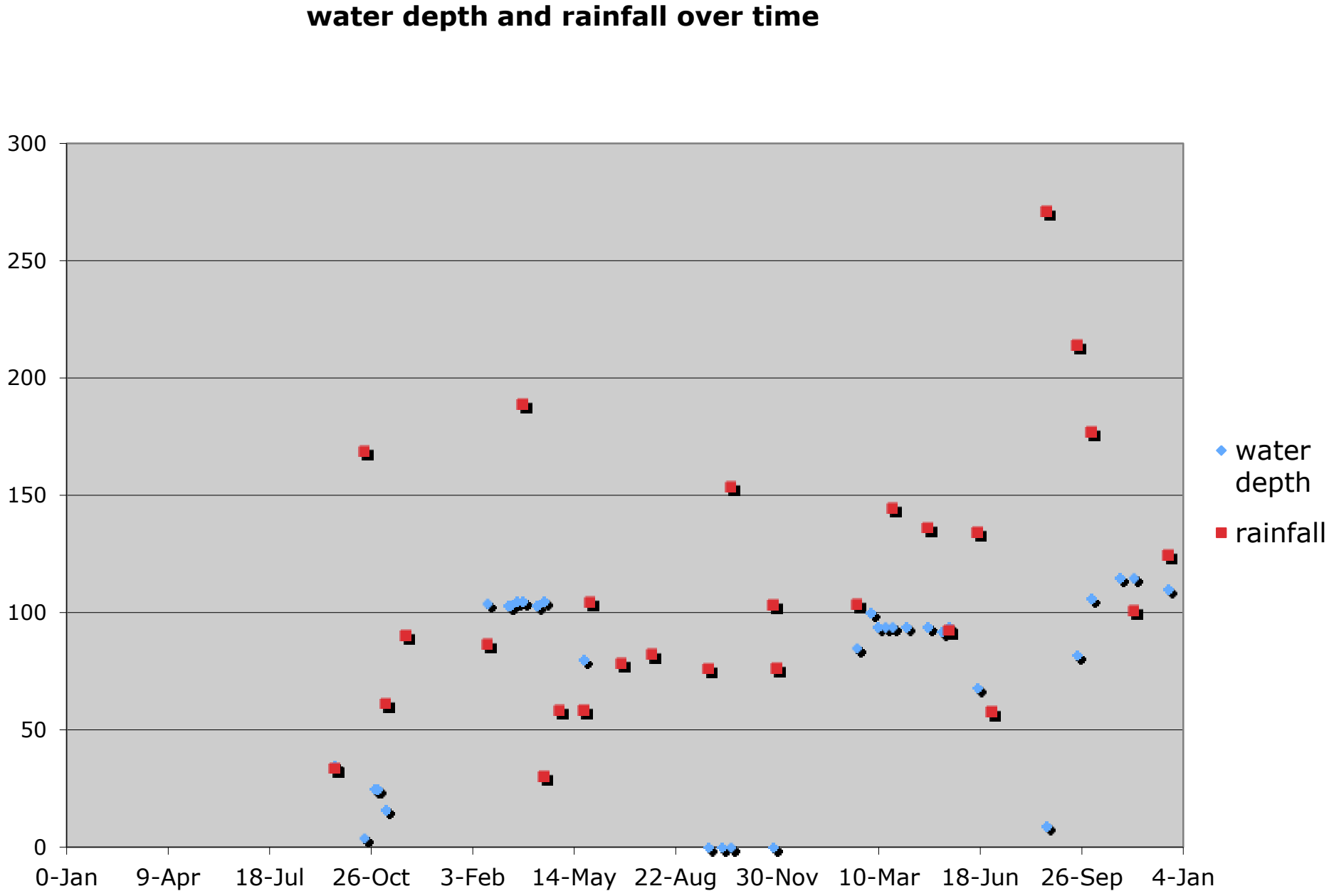
- We have data on pool depth, diameter, and water and air temperature for 5 years. We also have some data on organisms, such as first sighting of spermataphores, woodfrog and salamander egg masses and presence of larvae. This year we are starting to expand to include presence of different invertebrates.

How to use the data with students?

- The data as submitted to Harvard school yard project is not the easiest for middle school students to access.
- Too much information in spreadsheet
- 4 years ago Seth made a hand drawn graph of the data

	Teacher	Date	Julian		Dmax	Diameter	Depth	AirT	WaterT	precipitation
FPC	Gibson	9/21/09	264	264	27.1	9.2	35	19.5	14.5	
		9/30/09	273	273						33.7
FPC	Gibson	10/20/09	293	293	27.1	2.4	4	15.5	9	
FPC	Gibson	10/30/09	303	303	27.1	7.7	25	13	11	168.9
FPC	Gibson	11/2/09	306	306	27.1	7.8	24.9	10.5	9.5	
FPC	Gibson	11/10/09	314	314	27.1	6.3	16	20	12	
		11/30/09	334	334						61.4
		12/30/09	364	364						90.4
		1/30/10	30	394						68.1
FPC	Gibson	2/18/10	49	414	18.5	18.5	104	4	NA	
		2/28/10	59	424						86.6
FPC	Gibson	3/11/10	70	435	18.5	17.5	103	9	2	
FPC	Gibson	3/12/10	71	436	18.5	17.6	103	5	4	
FPC	Gibson	3/19/10	78	443	18.5	17.3	105	18	9	
FPC	Gibson	3/25/10	84	449	18.5	17.6	105	12	11	
		3/30/10	89	454						189
FPC	Gibson	4/8/10	98	463	18.5	17.6	103	25	20	
FPC	Gibson	4/15/10	105	470	18.5	18.5	105	18	13	
		4/30/10	120	485						30.3
FPC	Gibson	5/24/10	144	509	18.5	14.2	80	25	18	58.5
		5/30/10	150	515						58.5
		6/30/10	181	546						104.7
		7/30/10	211	576						78.5
		8/30/10	242	607						82.3
FPC	Gibson	9/24/10	267	632	18.5	0	0	24	NA	
		9/30/10	273	638						76.2
FPC	Gibson	10/7/10	280	645	18.5	0	0	14	NA	
FPC	Gibson	10/16/10	289	654	18.5	0	0	16	NA	
		10/30/10	303	668						153.8
FPC	Gibson	11/27/10	331	696	18.5	0	0	2	NA	
		11/30/10	334	699						103.4
		12/30/10	364	729						76.4
		1/30/11	30	395						61.9
FPC	Gibson	2/17/11	48	778	18.5	NA	85	12	1	
		2/28/11	59	789						103.7
FPC	Gibson	3/3/11	62	792	18.5	NA	100	-3	0	
FPC	Gibson	3/10/11	69	799	18.5	17.2	94	2.2	2.6	
FPC	Gibson	3/17/11	76	806	18.5	17.7	94	14.1	6.1	
FPC	Gibson	3/24/11	83	813	18.5	17.7	94	6	7	
		3/30/11	89	819						144.7
FPC	Gibson	4/7/11	97	827	18.5	17.7	94	12	11	
FPC	Gibson	4/28/11	118	848	18.5	17.7	94	26	20	
		4/30/11	120	850						136.3
FPC	Gibson	5/12/11	132	862	18.5	17.4	92	17	16	
FPC	Gibson	5/19/11	139	869	18.5	17.7	94	16	15	
		5/30/11	150	880						92.6
		6/16/11	167	897	18.5	14.8	68	26	23	
		6/30/11	181	911						134.4
		7/30/11	211	941						57.8
		8/23/11	235	965	18.5	1.45	9	21	21	
		8/30/11	242	972						271.1
		9/22/11	265	995	18.5	14.3	82	21	20	
		9/30/11	273	1003						214.1
		10/6/11	279	1009	18.5	17.1	106	13	12	
		10/30/11	303	1033						177.1
		11/3/11	307	1037	18.5	17.5	115	12	9	
		11/17/11	321	1051	18.5	17.5	115	5	7	
		11/30/11	334	1064						100.9
		12/21/11	355	1085	18.5	17.5	110	2	0	
		12/30/11	364	1094						124.7


water depth over a year
water depth cm
140
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
julian days
water depth 2009
water depth 2010
water depth 2011


water depth and rainfall over time
300
250
200
150
100
50
0
0-Jan
9-Apr
18-Jul
26-Oct
3-Feb
14-May
22-Aug
30-Nov
10-Mar
18-Jun
26-Sep
4-Jan
water depth
rainfall
month 2009-2011

2 years ago we did a lesson using modified data so we could use it to teach bivariate graphing

- Started with picking two columns to compare Line of best fit
- Introduce clustering, outliers, positive and negative association liner and non linear association

Shepley's Hill Vernal Pool Data 2009-2012

Date	Julian By year	Number of day from Jan1st 2009	Diameter (m)	Depth, (mm)	Air temp. (C)	Water Temp. (C)	Monthly Precipitation (mm)
9/21/09	264	264	9.2	35	19.5	14.5	
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9/30/10	273	638					76.2
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10/30/10	303	668					153.8
11/27/10	331	696	0	0	2	NA	
11/30/10	334	699					103.4
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1/30/11	30	395					61.9
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Shepley's Hill Vernal Pool Data 2009-2012 cont…..

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11/17/11	321	1051	17.5	115	5	7	
11/30/11	334	1064					100.9
12/21/11	355	1085	17.5	110	2	0	
12/30/11	364	1094					124.7
1/30/12	30	1125					58.6
2/2/12	33	1128	17.45	112	1	1	
2/29/12	60	1155					27
3/2/12	62	1157	17.5	117	0	0	
3/8/12	68	1163	17.5	118	19	11	
3/11/12	71	1166	17.5	118	13	11	
3/16/12	76	1171	17.5	118	5	7	
3/30/12	90	1185					23.7
4/26/12	117	1212	17.5	117	12	14	
4/30/12	121	1216					56
5/11/12	132	1227	17.5	118	14	12	

Massachusetts common core standards for math, March 2011

- Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

Moving on to embrace the Next Generation Science Standards

- http://www.nextgenscience.org/sites/ngss/files/MS-LS2 5.24.13with footer.pdf
- http://www.nextgenscience.org/sites/ngss/files/MS-LS1 6.18.13with footer.pdf

Science and engineering practices in NGSS

- 1. Asking questions (for science) and defining problems (for engineering)
- 2. Developing and using models
- 3. Planning and carrying out investigations
- 4. Analyzing and interpreting data
- 5. Using mathematics and computational thinking
- 6. Constructing explanations (for science) and designing solutions (for engineering)
- 7. Engaging in argument from evidence
- 8. Obtaining, evaluating, and communicating information

Observations and inferences have been central to this unit in the past. Where do observations come into the standards?

- **Asking questions** and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

Ask questions (from NGSS science practices)

- That arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- To identify and/or clarify evidence and/or the premise(s) of an argument.
- To determine relationships between independent and dependent variables and relationships in models.
- To clarify and/or refine a model, an explanation, or an engineering problem.
- That require sufficient and appropriate empirical evidence to answer.
- That can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
- That challenge the premise(s) of an argument or the interpretation of a data set.

Key themes that align with the NGSS

- Describing the pool using observations and data(*practices: ask questions; analyzing and interpreting data*)
- Describing pool organisms using observations*(practices: ask questions; connections to nature of science: scientific knowledge assumes a order and consistency in natural systems LS2-3)*
- Making inferences about adaptations observed that enable these organisms to survive and breed (*practices: argument with evidence, core ideas: LS1.B)*

- Using observations and research show how organisms are connected in the energy flow among the living and non living parts of the pond- food web

(*core ideas: cycle of matter and energy transfer in ecosystems LS2-3; interdependent relationships in ecosystems LS2-1; practices: obtaining, evaluating and communicating information)*

- Making predictions about how the organisms would be affected if the conditions of the pool changed significantly from the norm, for example a particularly dry spring. *(core ideas: Ecosystem dynamics, functioning and resilience, LS2-5); practices: engaging in argument from evidence)*

How this impacts our teaching of the unit

- Past approach has been to build an understanding of vernal pool and its creatures primarily through observation with some instruction of basic concepts such as lifecycles and food webs
- Students haven't needed much background information to be successful with the main parts of assessment
- New standards necessitate much more background understanding of concepts : oxygen flow through ecosystem, energy, lifecycles, competition for resources, decomposition…
- In addition there is greater emphasis at 6-8grade level on obtaining and analyzing quantitative data
- How to incorporate NGSS and maintain a primarily exploratory/inquiry driven approach within a 6-8 week unit?

Still working on a solution!

Things to keep:

- Initial open exploratory visit to pool, observations of pool, sampling and examination of organisms
- Examination of past data on pool (incorporate math assessment on graphing?)
- Choice of which organism(s) to study in depth
- Observational drawings using microscopes
- Some research using guides and internet
- Making inferences based on observations and research

Ideas

- Driving question :Why live in a wicked big puddle? What are the benefits and difficulties of living in a vernal pool?
- Students choose a theme- oxygen; food; reproduction/life cycle; surviving dry periods,
- Teacher provides tutorials and research material focused on specific themes so students just access what they need for their choice.
- Assessment includes observations of pool and reference to past data, observations of organism and inferences about adaptations with connections to chosen theme
- Have some sort of class share out of work- workshop style? (we just did an OP)

Don’t forget -the most important thing is getting them out into the natural world!